USRA Researcher

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RIACS Researchers Turning Speech Into Script

Image courtesy of NASA

The semi-autonomous Personal Satellite Assistant will be a grapefruit-sized floating sphere that will use air fans to navigate freely in the orbiting spacecraft.

USRA scientists at the Research Institute for Advanced Computer Science (RIACS) at the NASA Ames Research Center are developing an architecture to implement spoken natural language commands to a semi-autonomous robot intended for deployment on the International Space Station. The robot, called the Personal Satellite Assistant (PSA), will be a grapefruit-sized floating sphere that will navigate freely in the orbiting spacecraft, taking measurements of temperature, oxygen levels, air pressure, and other variables; it will act as a backup to a system of fixed sensors. The PSA will be controlled primarily by voice commands as interpreted by the RIACS speech-to-script architecture.

Beth Ann Hockey and Frankie James, who together comprise the RIACS Language Interfaces and Speech Technology—or RIALIST—group, are working on software that will enable an array of semi-autonomous systems such as the PSA to carry out spoken commands. The central idea is to transform input speech through successive levels of representation corresponding roughly to linguistic knowledge, dialogue knowledge, and domain knowledge. The final representation is an executable program in a simple scripting language equivalent to a subset of CSHELL, a UNIX-based scripting language.

The input speech signal is converted first into text by a recognition engine and then by syntactic and semantic parsing into a logical formula, which abstractly represents the user's intended command. Information that depends upon context is then added to translate this formula into a script. Finally, a simulation is run to determine what would happen if the script were executed. If the simulation indicates problems, the system works on resolving them; otherwise the script is sent for execution. In modeling the interpretation process—which converts the input (speech) signal to the output (executable) representation—the RIALIST group started with the basic assumption that interpretation is a process often given to failure. For a number of reasons (users may express themselves unclearly or incompletely, for example) the system may seriously fail to understand exactly what is intended.

Image courtesy of NASA

The RIACS approach builds into the architecture this possibility of interpretation failure, treating it as a normal part of processing. This is

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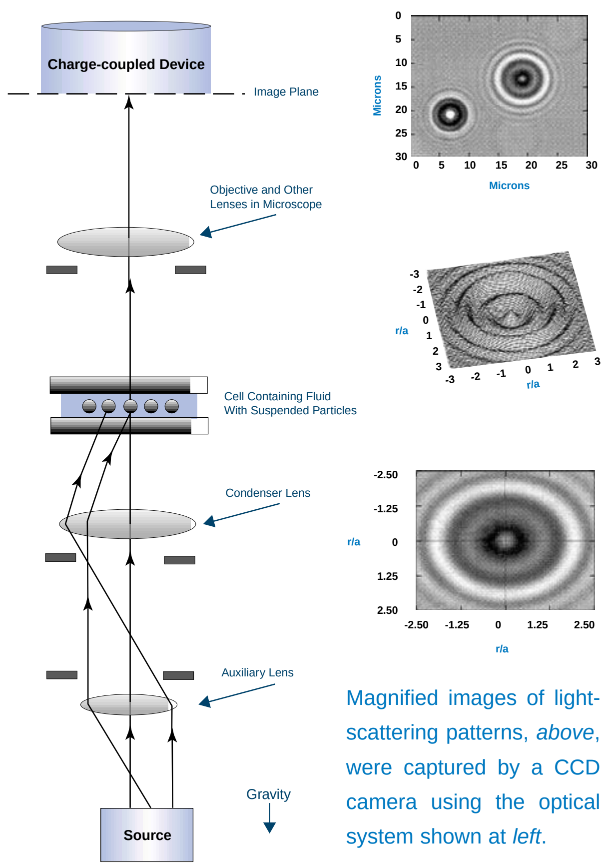
Measuring Fluid Speeds in Microscopic Volumes

On Earth, gravity rules: mountain streams cascade down to the plains and into great rivers to the sea; wine tumbles from the mouth of a bottle down into a waiting glass. But in the effective absence of gravity within an orbiting spacecraft, fluids behave completely differently; surface forces often dominate. Understanding fluids in this unfamiliar environment requires detailed investigation of flows at liquid-gas interfaces and liquid-wall contacts. Techniques are needed that are capable of precision measurement of fluid velocities within microscopic regions. Ben Ovryn has developed such a technique. Ovryn is a Principal Researcher at Case Western Reserve University in Cleveland, a USRA member university, and a staff scientist at USRA's National Center for Microgravity Research on Fluids and Combustion, located at the CWRU campus and the NASA Glenn Research Center.

There is an important class of space experiments that require study of microscopic volumes of fluids. Kevin P. Hallinan of the University of Dayton used the technique to investigate the fluid physics of an evaporating fluid near the points where the meniscus contacts a wall. Peter C. Wayner, Jr., of Rensselaer Polytechnic Institute, a USRA member university, is investigating a novel heat exchanger for space applications using an evaporating and condensing fluid within a closed tube. Both of these investigators could benefit from an instrument that measures fluid velocities in a microscopic field of view.

Ovryn's initial idea for his technique evolved from squinting through a microscope at a colleague's laboratory and observing that tiny dust particles in a fluid produced light-scattering patterns. "Somewhat like ripples on a lake when you toss in a pebble," Ovryn says, adding, "The idea sprang from the dust." Then he made the key observation that, as the fluid moved, carrying along the particles, the patterns changed. He realized that analysis of the patterns could yield the position of the particles in three dimensions, and tracking these positions would give the velocity distribution within the fluid.

Light scattering by irregular particles of room dust is quite complicated to analyze. But the theory of light scattering by spherical particles was fully developed by the German scientist Gustov Mie in the early 1900s. The theory is complex, but modern high-speed computers make the difficult calculations feasible. Challenges arose in modeling the effects of the microscope and refraction.



Magnified images of light-scattering patterns, *above*, were captured by a CCD camera using the optical system shown at *left*.

Figure 1.

In Ovryn's technique, the microscopic fluid sample is illuminated by light that passes through a system of lenses. Fluid motions are tracked through determination of the positions of tiny polystyrene spheres that are carried along by the fluid. Position along the line of sight comes from analysis of the light-scattering pattern. The relevant parameters—sphere radius, index of refraction of the sphere and fluid, wavelength of the illuminating light, and lens properties—are used to compute the scattering patterns and stored in a computer database. The observed light-scattering pattern is measured with a CCD (charge-coupled device) camera, and the in-line position is found through computer matching with the pre-computed patterns. In-plane position is found from the position of the center of the pattern. (See Figure 1.) Velocity is

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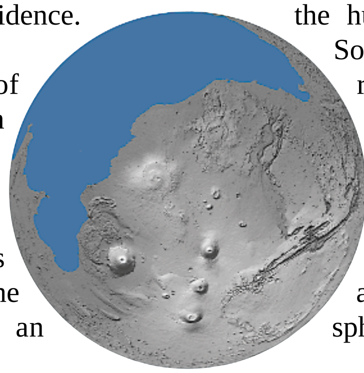
An Ancient Ocean on Mars?

A USRA Scientist Collaborating on a Study of Mars' Surface Believes the Red Planet Probably Held an Ancient Hemispheric Ocean

While findings by Michael Malin and Kenneth Edgett recently published in *Science* suggest the presence of groundwater seepage on Mars in the not-too-distant past (<10 million years ago), USRA scientist Stephen Clifford has been looking further back—and sees evidence of a former ocean. Clifford, a planetary scientist at the Lunar and Planetary Institute in Houston, believes that ~4 billion years ago an enormous ocean probably covered most of the Martian northern hemisphere. Clifford's studies were carried out in collaboration with Timothy Parker of the Jet Propulsion Laboratory, who was the first to suggest the possibility that Mars once possessed a hemispheric ocean, based on a variety of geologic evidence.

Parker's tentative identification of possible ancient ocean shorelines on Mars was based on his previous geological field work for the U.S. Air Force in characterizing potential future MX missile bases in Utah. It was during this time that he became familiar with the paleoshorelines of Lake Bonneville, an enormous ancient lake that once covered much of what is now Utah and Nevada. After completing his work for the Air Force, Parker's interests turned to planetary science, where he was struck by the similarities between the geologic features associated with the former shorelines of Lake Bonneville and images of the northern plains of Mars returned by the Viking mission in the mid-to-late 1970s.



Flat regions encompassing most of the northern hemisphere of Mars are contained within a boundary of nearly constant elevation which could well be an ancient shoreline. *Image courtesy of NASA*

Recently, a team of scientists led by James Head of Brown University, a USRA member institution, has published additional evidence in support of the Martian ocean hypothesis. Using precision altimeter data from the Mars Orbiter Laser Altimeter aboard the Mars Global Surveyor spacecraft, the team noted that the area surrounding the Martian north pole and covering much of the northern hemisphere is remarkably flat and smooth. Such features resemble regions on the Earth that have been smoothed by hydraulic action and heavy sedimentation. Moreover, this flat region, encompassing most of the northern hemisphere of the planet, is contained within a boundary of nearly constant elevation which they conclude could well be an ancient shoreline.

However, Clifford and Parker have addressed the case for a former ocean on Mars from a different perspective. They considered the geologic and climatic conditions on the planet that are thought to have existed at the time the huge outflow channels leading from the Southern Highlands toward the equatorial region were formed. These channels—up to several hundred kilometers wide and many hundreds to thousands of kilometers long—are thought to have resulted from the catastrophic discharge of groundwater from a subpermafrost aquifer in the planet's southern hemisphere. Extrapolating these hydraulic and thermal conditions backward in time, Clifford and Parker conclude that a huge, ice-covered ocean must have covered the planet's northern plains throughout its first 1 or 2 billion years of geologic history—long before the floods that cut the outflow channels occurred. In their interpretation, the ocean water eventually was assimilated as ground ice and groundwater within the crust. In time, this led to a hydrostatic imbalance that explained the later channel-cutting floods from the southern aquifer. They suggest that a substantial remnant of the original ocean continues to survive "as massive ice deposits within the northern plains." The existence of such water reservoirs would clearly enhance the feasibility of eventual human exploration and colonization of the planet, and would hold significant implications for the existence of life on Mars.

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USRA Establishes Scholarship Program

In keeping with USRA's interest in furthering education in the space sciences and helping future leaders in space science and technology in their pursuits, the Association has established the USRA Scholarship Program. Funds for these academic scholarships are distributed from USRA's two educational memorial funds—The James B. Willett Educational Memorial Fund and The John R. Sevier Memorial Scholarship Fund.

USRA established the two memorial funds in 1998 and 1999 in memory of two USRA scientists who had extensive and distinguished careers in the space industry. (See page 5.)

For the 2000–2001 academic year, USRA awarded two $500 scholarships. A James B. Willett Memorial Scholarship was awarded to Sarah Johnson from Lexington, KY. A senior this fall at Washington University in St. Louis, Ms. Johnson expects to graduate in 2001 with a triple major in Mathematics, Earth and Planetary Sciences, and Environmental Studies. A John R. Sevier Memorial Scholarship was awarded to Aleksandr Pelts from Philadelphia, PA. Mr. Pelts will be a junior this fall at Drexel University in Philadelphia, majoring in Computer Science; he expects to graduate in 2002.

Students and faculty at academic institutions were notified of USRA's scholarship opportunities by the distribution of information packages, as well as through USRA's Web site (*http://www.usra.edu/scholarships*). About 200 information packages were sent out in preparation for this year's scholarship awards, and 109 applications were received from students at many universities and colleges, representing diverse fields of study.

Sarah Johnson from Lexington, KY, *left*, and Aleksandr Pelts from Philadelphia, PA are the first students awarded a USRA scholarship.

To apply for a USRA scholarship, visit www.usra.edu/scholarships/overview.html to download PDF versions of the application and recommendation forms. Applications for the 2001–2002 school year will be accepted between October 1, 2000 and May 1, 2001.

After the applicant pool was narrowed to 10 potential recipients by USRA's Directors of University Relations, the final two recipients were selected by USRA's Scholarship Selection Committee. This committee consists of four scientists from different disciplines: Harold Brody from the University of Connecticut, Walter Haisler from Texas A&M University, John Hoffman from the University of Texas at Dallas, and Jim Houck from Cornell University.

Successful applicants must be U.S. citizens, full-time undergraduates of a 4-year accredited university and show a career interest in the physical sciences or engineering with an emphasis on space research and space science education. The application process consists of an application form, an essay, a transcript, and two letters of recommendation. Recipients may re-apply for a second year. ❑

If you wish to donate to either of the memorial funds, please send a check payable to USRA c/o the respective fund, to:

USRA Memorial Funds
American City Building
10227 Wincopin Circle, Suite 212
Columbia, MD 21044

Respective families are notified of all donations.

USRA's Memorial Scholarship Funds

James B. Willett

The **James B. Willett Educational Memorial Fund** was established in memory of James B. Willett, an exemplary scientist and administrator with a distinguished career in the space industry.

A native of Lexington, KY, Willett earned his B.S. in Physics and Mathematics from the University of Kentucky in 1962. He went on to graduate school at Indiana University, earning both his M.S. (1964) and Ph.D. (1969) degrees in Physics. His research included precision parameterization of beta-decay spectra for determining the end point energies and the development of experiments and analysis techniques to accurately measure internal conversion coefficients in nuclear decays.

Two years after being awarded a National Research Council postdoctoral fellowship at the Jet Propulsion Laboratory in 1971, Willett became a permanent member of the JPL staff, working under Allen S. (Bud) Jacobson. During his postdoctoral tenure at JPL, Willett found the opportunity to apply his experience in nuclear spectroscopy to the search for gamma-ray line emission of cosmic origin. In 1980, Willett went on to the Galileo project at JPL, where he was responsible for science operations. In 1990, Willett moved to NASA Headquarters in Washington, D.C., where he applied his broad background in space research to help successfully navigate the Mission Operations and Data Analysis program into the new environment of faster-better-cheaper missions and increasingly consolidated mission operations. Willett's final employer was USRA, where he acted to better tie the Association to its member universities and, toward this end, began building a substantial database of university researchers. Willet helped to define the role now known as USRA's University Directors (see page 8).

Willett had an exceptionally high level of credibility within the scientific community, which recognized him as one who truly understood the needs of the scientists and did his utmost to satisfy them. ❑

John R. Sevier

The **John R. Sevier Memorial Scholarship Fund** was established in memory of John R. (Jack) Sevier, who led an outstanding career in the space industry as an engineer, a program manager, and an education coordinator, playing important roles in the Apollo, Skylab and Shuttle endeavors.

A native of Hampton, VA, Sevier received his M.S. in Aeronautical Engineering from the University of Virginia in 1953, then went on to perform research in aerodynamics and magnetohydrodynamics at the Langley Research Center.

After receiving his M.S. in Physics in 1962 from the College of William and Mary, Sevier joined the Apollo Program in Houston, serving as Chief of the Operations Analysis Branch, Chair of the Apollo Mission Planning Task Force, Mission Staff Engineer to the Apollo Program Manager for Apollo 11, Manager of the Mission Control Spacecraft Analysis Room for Apollo 12, 13 and 14, and as Team Leader in the Mission Control Science Support Room for Apollo 15, 16 and 17. Sevier next moved to Skylab to serve as Deputy Program Manager, then served as Chief of the Integration Division of the Program Operations Office at JSC. In 1977, Sevier joined USRA as Associate Director of the Lunar and Planetary Institute in Houston. During his impressive tenure at USRA, Sevier served as Executive Secretary of the Lunar and Planetary Review Panel, Deputy Director of USRA's Division of Space Biomedicine (now the Division of Space Life Sciences), and directed the NASA/USRA University Advanced Design Program. In 1989, Sevier took on the additional role of Director of USRA's Division of Educational Programs, coordinating several programs enabling student involvement in NASA programs, such as the Student Explorer Demonstration Initiative (STEDI) program, predecessor to NASA's successful University Explorer Program.

Sevier was considered an outstanding person by his peers, both professionally and personally. His contributions to the space industry were highly regarded, and greatly beneficial to the science community. ❑

SOFIA Moving Towards First Light

Critical Design Review Cleared, Program Moves into "Manufacturing" Stage

Scientists and engineers in the United States and Europe are continuing to develop and build the components needed to enable the Stratospheric Observatory For Infrared Astronomy, or SOFIA, to achieve first light. On August 17, SOFIA successfully completed its Critical Design Review, enabling the program to move into its Fabrication and Integration phases.

NASA and the German Aerospace Center, DLR, are working together to develop, build, and fly SOFIA, a 2.5-meter (8-foot) infrared telescope mounted in a modified Boeing 747SP aircraft. The world's largest airborne observatory, SOFIA is scheduled to conduct science activities for 20 years beginning in 2003. Flying above more than 99.9 percent of the Earth's obscuring water vapor at altitudes up to 45,000 feet, it will enable scientific observations impossible for even the largest and highest of the great Earth-based telescopes.

Managed and operated by USRA as NASA's prime contractor, SOFIA will investigate such astronomical phenomena as:

Physics of interstellar clouds and star formation in our galaxy

- Proto-planetary disks and planet formation in nearby star systems
- Origin and evolution of biogenic atoms, molecules and solids

Composition and structure of comets and planetary atmospheres and rings

- Star formation, dynamics, and chemical consistency of other galaxies
- The dynamic activity in the center of the Milky Way.

Today, the SOFIA aircraft is housed in Raytheon's Aircraft Integration Systems hangar in Waco, TX, where it is being modified to house a 40,000-pound telescope floating on a spherical hydrostatic bearing and stabilized by gyroscopes in an open port cavity.

The telescope and its mirror are being built in Germany by a consortium of DLR subcontractors, including MAN Technologie and Kayser-Threde.

In 2002, the USRA team will fly the aircraft to Germany, where they will work with the DLR team to integrate the telescope; the airborne observatory will then be flown to its home base, the NASA Ames Research Center near Mountain View, CA. SOFIA will make scientific flights three to four times per week, primarily from Ames and, for one or two months per year, from a base in the southern hemisphere; it will occasionally fly from other locations around the world as well.

Hangar N-211 at Ames is being reconfigured to become an observatory ground base featuring an aircraft support system—in addition to the same kind of science-related infrastructure that typically supports terrestrial telescopes.

USRA SOFIA teammate United Airlines will fly and maintain the plane. UAL will build and staff a dedicated SOFIA service capability within the hangar for day-to-day servicing and maintenance of the 747SP.

A unique aspect of SOFIA is the integration of Education and Public Outreach, or EPO, into the layout of the observatory and hangar. The plane's first-class section is being converted into seating for visitors, so that flights can include educators from K–12 schools, colleges, universities and science and technology museums. Now being built into

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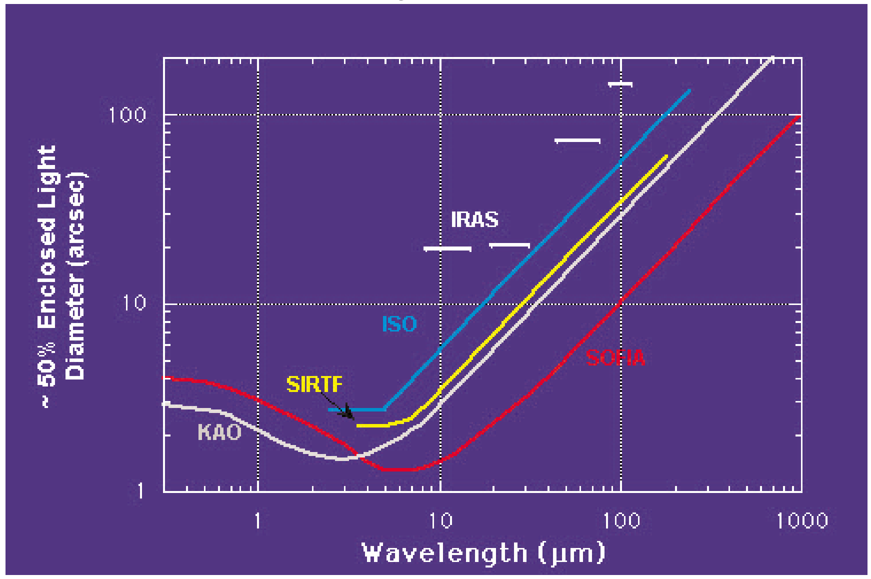
Angular Resolution

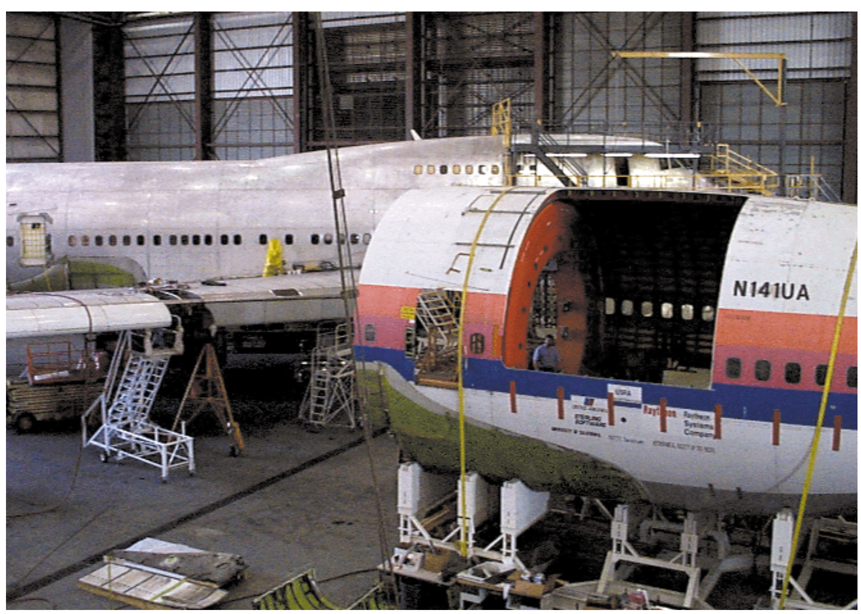


This graph depicts the expected angular resolution for SOFIA compared to other NASA missions, including the Space Infra-red Telescope Facility (SIRTF), Kuiper Airborne Observatory (KAO), and Infra-Red Astronomy Satellite (IRAS).

Angular resolution is a measure of how much detail can be resolved in an astronomical object. For example, at 60 microns, SOFIA can resolve (separate in space) two objects that are 6" apart, three times better than with the 18" angular resolution on the KAO.

With this unprecedented angular resolution, it will be possible to resolve stars and protostars that have been found in regions of high star formation, such as the Orion Molecular cloud complex. Astronomers will be better able to discover clues to star formation, the structures and environments of molecular clouds, and the nature and evolution of protoplanetary disks around nearby stars.

The vertical axis is the 50% enclosed light diameter (in seconds of arc), with wave-length in microns (10-6 meters) along the horizontal axis.



*(**Right**) Present and Future: A full-scale mock-up of the 747 section that will house the telescope (foreground) sits nearby the SOFIA aircraft itself at a Raytheon Systems Company hangar in Waco, TX. As an indication of scale, note the worker in the lower left corner of the mock-up's cut-out.*

Member Universities

Alabama, A&M University
Alabama, University of, in Huntsville
Alaska, University of, Fairbanks
Arizona, University of
Arizona State University
Boston College
Boston University
Brandeis University
British Columbia, University of
Brown University
California, University of, Berkeley
California, University of, Los Angeles
California, University of, San Diego
California, University of, Santa Barbara
Case Western Reserve University
Chicago, University of
Colorado, University of, Boulder
Connecticut, University of
Cornell University
Delaware, University of
Denver, University of
George Washington University
Georgetown University
Georgia Institute of Technology
Hampton University
Harvard University
Hawaii, University of, Manoa
Houston, University of
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Mississippi State University
New Hampshire, University of
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Florida State University
New Mexico, University of
New Mexico State University
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New York, State University of, Stony Brook
New York University
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Tennessee, University of
Texas, University of, Austin
Texas, University of, Dallas
Texas, University of, Medical Branch, Galveston
Texas A&M University
Toronto, University of
Utah State University
Vanderbilt University
Virginia, University of
Virginia Polytechnic Institute and State University
Washington, University of
Washington University in St. Louis
William and Mary, College of
Wisconsin, University of, Madison
Yale University

University Relations Directors Serve as Direct Link to Member Universities

USRA has signed on two scientists at the corporate level to enhance the direct participation of its member universities in the Association's various space-related research efforts. As Directors of University Relations, Jacques L'Heureux and Hussein J. Hussein provide a direct link between member schools and the many ongoing research endeavors managed by USRA. Technical areas are split between the two Directors, with Hussein concentrating on space technology, microgravity, and fluid mechanics, and L'Heureux focusing on the space, Earth and life sciences. The directors serve as the primary points of contact for member institution representatives, periodically visiting member university campuses, and keeping abreast of ongoing research by attending USRA science council meetings, workshops, etc. L'Heureux and Hussein are also expanding and evolving the USRA University Resources Database, a considerable compilation of information about researchers, their areas of expertise, contact information, and research facilities important to the community. To submit information to the URD, go to http://database.usra.edu/announce/urd.html.

Hussein Hussein

Brooks Glogau Photographers

Jacques L'Heureux

David Cummings, USRA's Executive Director, created the new positions. "We brought in Jacques and Hussein to ensure that we keep in close touch with, and are responsive to, the universities that comprise USRA," said Cummings. "I'm pleased to say that I think it's working; I think we're closer now to our schools, know more about what they're doing, and vice-versa."

Hussein Jirdeh Hussein, Director of University Relations, Space Technologies, received his doctorate in Mechanical Engineering from the State University of New York at Buffalo, a USRA member institution. His research interest is in experimental fluid mechanics, turbulent flows, and space applications.

Jacques L'Heureux, Director of University Relations, Space Sciences, earned his doctorate from the University of Chicago, a USRA member institution. He has been manager and co-investigator on numerous research projects and has extensive experience in experimental astrophysics and project management. ❑

Search Underway for New USRA President

Paul J. Coleman, Jr., who served as President of USRA since 1981 and oversaw a twenty-fold increase in the activities of the Association, announced his resignation last March. David C. Black has been appointed Interim President until a formal selection of the next president is made.

Board of Trustees vice-chair Robert Carovillano heads a Presidential Search Committee charged with selecting the next President of USRA. The Committee seeks an articulate leader of repute in one of the principal scientific or technical disciplines, possessing significant successful experience in administration, research management, and grants procurement. The selected individual will garner the respect of colleagues in space research communities and will advance the goals of USRA to fulfill its mission of promoting programs in space research and technology, and international space exploration. Credential review is currently underway and will continue until the search is completed. Nominations, expressions of interest, and inquiries may be directed to any member of the Search Committee (below) or to Ms. Nancy Archer-Martin at (508) 228-6700 (e-mail: usra@emnemn.com).

USRA Presidential Search Committee

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Gerald Griffin, (830) 238-4036, ggriffin@ktc.com
Norman Ness, University of Delaware, (302) 831-8116, nfness@bartol.udel.edu
Dietrich Müller, University of Chicago, (773) 702-7846, muller@odysseus.uchicago.edu
Margaret Rhea Seddon, Vanderbilt University Medical Center, (615) 343-0302, rhea.seddon@mcmail.vanderbilt.edu

USRA Restructures Corporate Management

Early this year, USRA restructured its top management roles, eliminating "Division Director" positions and creating three "Vice President" slots, for Earth Science, Space Science, and Space Technology, respectively. A "Chief Engineer" position was also created, and the Association's Executive Director was given the additional title of "Senior Vice President."

David C. Black, Vice President, Space Science, oversees USRA's programs in planetary science, astrophysics, astronomy, space physics, and associated instrumentation and technologies. (Black is also serving as Interim President.)

W. David Cummings was appointed Senior Vice President of the Association. He is also Executive Director and Secretary/Treasurer. Cummings has served as Executive Director since 1976, prior to which he was at Grambling College (now Grambling State University). His primary research interest is in space plasma physics.

William E. Dean, Vice President, Space Technology, supervises initiatives to improve the cost and efficiency of space operations, and to investigate the feasibility of small, low-cost, university-designed and -built free-flying satellites.

Donald R. Johnson, Vice President, Earth Science, administers programs in Earth system science, with emphases on analysis and modeling of terrestrial, hydrospheric and atmospheric processes, and other enabling technologies.

Brooks Glogau Photographers

Lewis L. Peach, Jr., Chief Engineer, serves the President, Vice Presidents and USRA's programs and institutes in the areas of advanced technology development, a responsibility similar to his prior role at NASA Headquarters as Director of Advanced Projects for the Human Exploration and Development of Space (HEDS) Enterprise. ❑

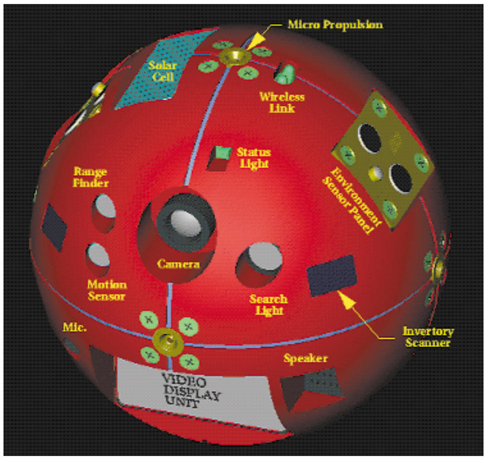

Image courtesy of NASA

An artist's rendering of the Personal Satellite Assistant.

***RIACS...**from p.1*

similar to how complex commands are interpreted by a computer operating system using a scripting language such as CSHELL, Perl, or Visual Basic. Scripting languages assume that commands often fail. For example, UNIX-based scripting languages provide each script with two types of output: "stdout" and "stderr." Intended output of successful processes is written to "stdout;" error messages, warnings and other comments are sent to "stderr."

Hockey and James adapted this notion of the "error stream" to their interpretation process. In the RIALIST system, the process of translating between levels of representation produces not only a simple output but also "meta" information describing how the output was produced. Each translation step produces an output (the representation produced), and a "meta-output," which provides information about how the translation was performed. The consistent use of this output/meta-output distinction permits a simple and clear treatment of apparently diverse topics, including resolution of pronouns, correction of user misconceptions, and optimization of scripts.

At a high level, the architecture works like this: interpretation proceeds as a series of non-deterministic translation steps, each producing a set of possible outputs and associated meta-outputs. The interface attempts to simulate execution of each possible script produced, in order to determine what would happen if that script were selected; simulated execution can itself produce further meta-outputs. Finally, the system uses the meta-output information to decide what to do with the various possible interpretations it has produced. Possible actions include selection and execution of an output script, paraphrasing meta-output information back to the user, or some combination of the two.

The following exchange employs the architecture's reference resolution (in correctly interpreting the phrase "all three decks") and plan optimization (in selecting the most efficient way to execute the command—in this case, starting with the closest deck and moving further away). To confirm that it is embarking on the correct course, the PSA paraphrases the resulting plan back to the user:

USER: Go to all three decks and measure carbon dioxide.

PSA: I will move to flight deck, mid deck and then lower deck and I will measure carbon dioxide levels, okay?

USER: Okay. [**PSA** moves to flight deck]

PSA: The carbon dioxide level at the flight deck is one percent. [**PSA** moves to mid deck]

PSA: The carbon dioxide level at the mid deck is one percent. [**PSA** moves to lower deck]

PSA: The carbon dioxide level at the lower deck is one percent.

The next example involves resolution of ellipsis; the relevant context is recovered from the preceding dialogue:

USER: Do the same for the pilot's seat.

PSA: I will move to the pilot's seat and I will measure carbon dioxide level, okay?

USER: Right. [**PSA** moves to pilot's seat]

PSA: The carbon dioxide level at the pilot's seat is one percent.

The speech and language processing architecture is made up of a suite of about 20 modules or agents, connected by SRI International's Open Agent Architecture™. Speech recognition is performed using software from Nuance Communications. Syntactic and semantic processing are done with the Gemini system from SRI, using a domain-independent unification grammar and a domain-specific lexicon developed at RIACS. Agents that perform contextual interpretation, translation between representations and dialogue management were also developed at RIACS. ❑

Researcher Editor Bill Davis Retires

Bill Davis, who served as Editor-in-Chief of USRA's newsletter (originally the USRA *Quarterly* and now the USRA *Researcher*) since 1989, has stepped down as Editor. Davis will continue to write and edit articles for the publication, with the assistance of Joann Temple Dennett. Davis and Dennett both reside in the Boulder, CO area, where the newsletter was produced until its recent move to the Washington, DC office (see back page).

USRA Executive Director David Cummings praised Davis. "Bill transformed the *Quarterly*, which was originally a typical in-house organ, with uninspired stories about personnel changes and the like, into a technically competent bulletin to university scientists and engineers about the more interesting research projects we're involved in. He singlehandedly made the newsletter an important link to our member schools."

In 1992, Davis and the USRA *Quarterly* received the Award of Excellence from the Society for Technical Communication, which cited the *Quarterly* as overall best in the category of "House Organs." ❑

Fluid Speeds...*from p.2*

determined from the movement of a sphere during a given time interval. Thus, three-dimensional microscopic flow fields are determined using light observed from a single direction. Ovryn's technique has been refined to the point where the three-dimensional position of a one-micron-sized sphere can be determined to nanometer precision. Given his success with "Forward-Scattering Particle-Image Velocimetry," as he refers to the technique, Ovryn says, "This is a good example of the merits of exploring fully whatever you observe—even if it arises from the dust of a messy laboratory!" ❑

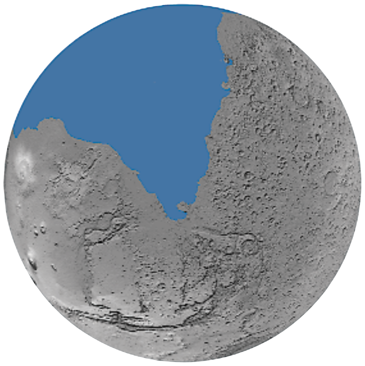

Image courtesy of NASA

Mars...*from p.3*

Evidence that water once existed on the surface of Mars also comes from the study of several meteorites known by their isotope composition to have come to Earth from Mars. Leslie Baker and coworkers at the University of Idaho compared the structure of the minerals in one of those meteorites with similar Earth minerals exposed to water under controlled conditions. Baker concluded that mineralogy suggests intermittent exposure to water before the rock broke from Mars and found its way to Earth. Complementary studies have been reported by Tim Swindle of the University of Arizona, a USRA member institution. ❑

SOFIA...*from p.7*

Hangar N-211 is an EPO area, including a classroom for pre-flight educator training. The SETI Institute and the Astronomical Society of the Pacific jointly manage SOFIA EPO activities.

The observatory's 10 initial instruments are being developed and built at institutions throughout the U.S. and Germany, including such USRA member universities as UCLA, Cornell University, the University of Chicago and the University of Texas at Austin. While these instruments complement each other with a mix of spectrometers and cameras working from optical to submillimeter (.03-600 microns) wavelengths, the observatory's scientific capabilities will be expanded further with a new round of instruments to be selected next year. ❑

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DC-Based USRA Team Inherits USRA Researcher

(***Left to right***) Contributing Editor Loretta Smerchansky, Editor Andrew Bradley and Associate Editor Jennifer Jones

Beginning with the current issue, the *USRA Researcher* is published from USRA's Washington, DC office. Andrew Bradley, New Initiatives Manager for USRA, is the *Researcher*'s new Editor. Associate Editor Jennifer M. Jones is the creative talent behind USRA's Web site and several print publications; and Contributing Editor Loretta Smerchansky is the Office Manager for the DC office.

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